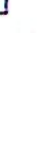
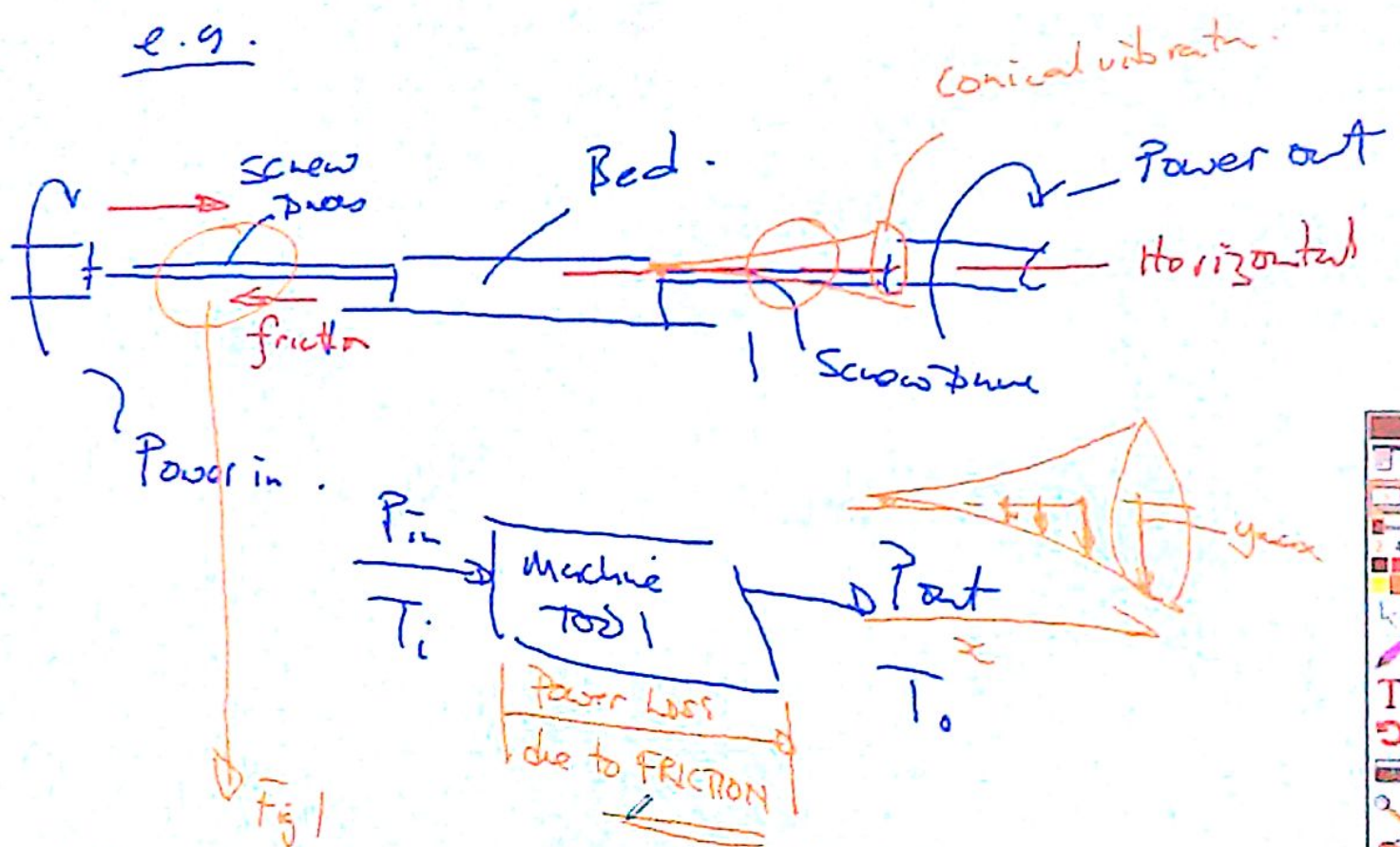
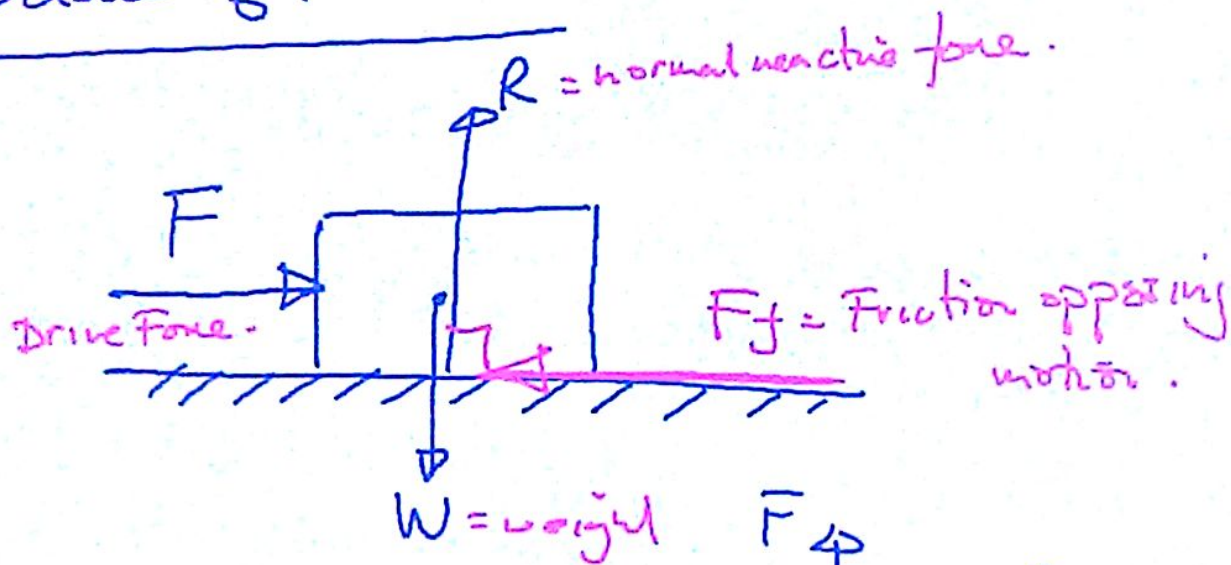


Transmission Angles and Machine Drives

e.g.

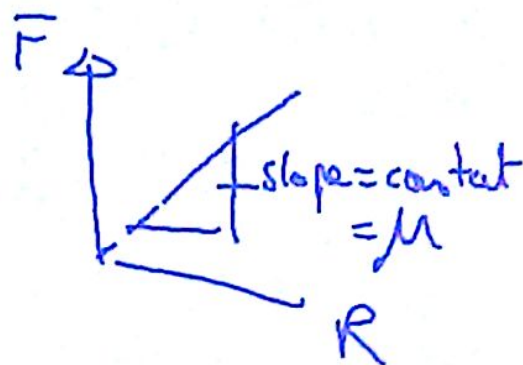


Basis of Friction

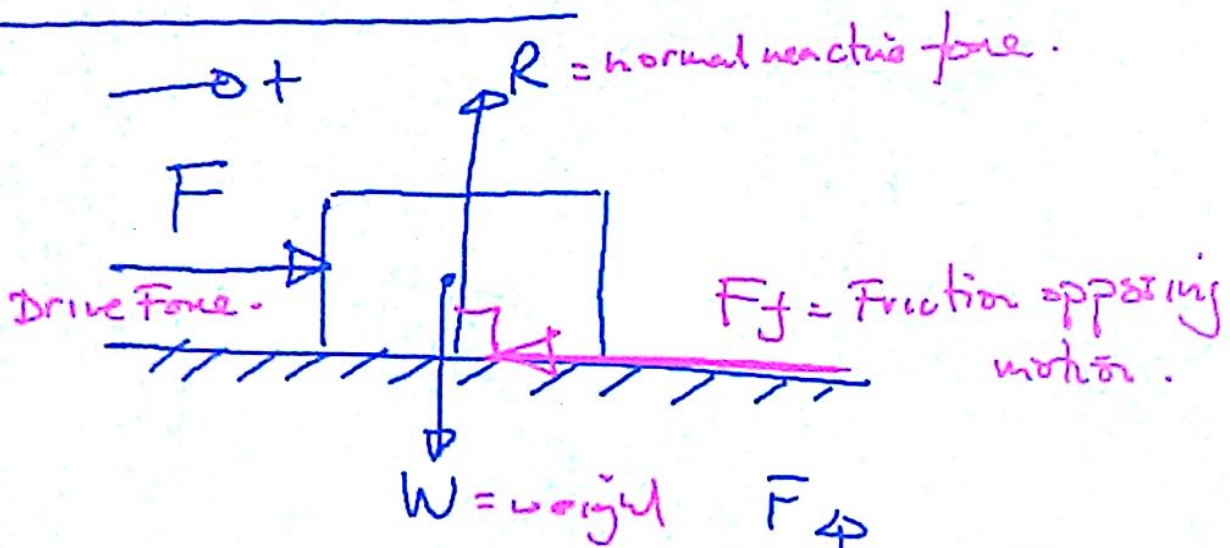


$$\Rightarrow \sum F = \mu \cdot \sum R$$

coefficient of friction!



Basis of Friction

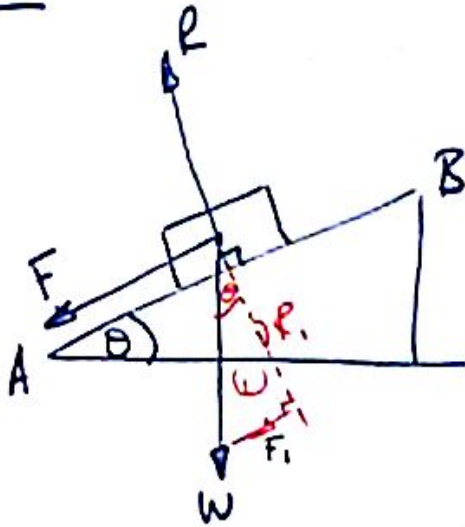


$$\Rightarrow \sum F = \mu \cdot \sum R$$

$$(F - F_f) = \mu R \text{ (coefficient of friction)}$$



Ex 1



$\theta = 13^\circ = \text{slide angle.}$

Find $\mu = ?$

Clue:

$$F = \mu \cdot R$$

$$\mu = \frac{F}{R}$$

From ① $\sin \theta = \frac{F_1}{W} \Rightarrow F_1 = W \sin \theta \quad \text{--- ①}$

$\cos \theta = \frac{R_1}{W} \Rightarrow R_1 = W \cos \theta \quad \text{--- ②}$

From ① : $\sin \theta = \frac{F_1}{W}$

From ② : $\cos \theta = \frac{R_1}{W}$

OR

$$\frac{F_1}{R_1} = \frac{W \sin \theta}{W \cos \theta} = \tan \theta$$

" μ "

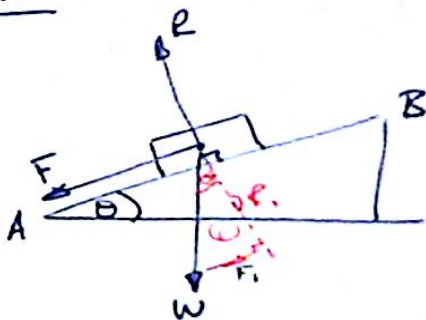
∴ Since

$$\frac{F}{R} = \tan \theta = \mu$$

$$\Rightarrow \text{coefficient of friction} \Rightarrow \tan \theta$$
$$= \tan (13^\circ)$$
$$= \underline{\underline{0.23}}$$

$$\boxed{\therefore \mu = 0.23.}$$

Ex 1



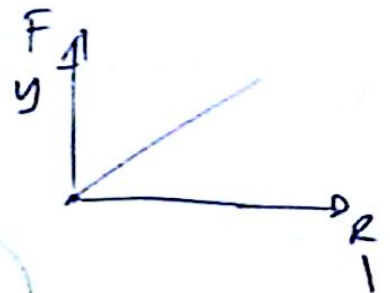
$\theta = 13^\circ$ = slide angle.

Find $\mu = ?$

Clue:

$$F = \mu R$$

$$\mu = \frac{F}{R}$$



From ① $\sin \theta = \frac{F_1}{W} \Rightarrow F_1 = W \sin \theta$ — ①

$$y = \mu x$$

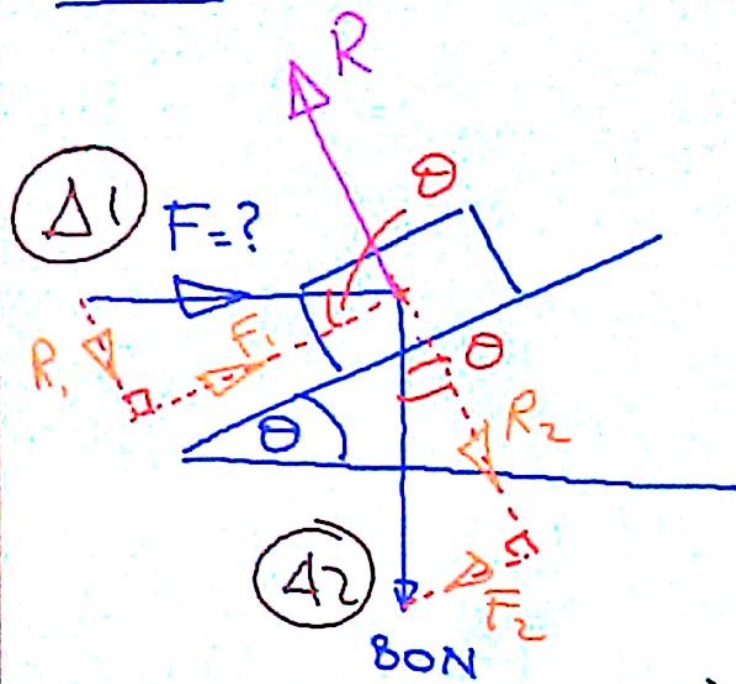
— "u" —

Ex 2.

$$\theta = 12^\circ$$

$$\mu = 0.4$$

Let F = Horizontal force
to just start motion
up the plane.



From $\Delta 1$

$$\sin \theta = \frac{R_1}{F}$$

$$\Rightarrow \boxed{R_1 = F \cdot \sin \theta} \quad \text{--- (1)}$$



$$\cos \theta = \frac{F_1}{F}$$

$$\therefore \boxed{F_1 = F \cos \theta} \quad \text{--- (2)}$$

From $\Delta 2$

$$\sin \theta = \frac{F_2}{80}$$

$$\Rightarrow \boxed{F_2 = 80 \sin \theta} \quad \text{--- (3)}$$

$$\cos \theta = \frac{R_2}{80}$$

$$\Rightarrow \boxed{R_2 = 80 \cos \theta} \quad \text{--- (4)}$$

$$\cos \theta = \frac{F_1}{F}$$

$$\therefore \boxed{F_1 = F \cos \theta} \quad (2)$$

$$\text{Since } F = \mu R.$$

$$\Rightarrow \sum F = \mu \cdot \sum R$$

$$\therefore F_1 - F_2 = \mu (R_1 + R_2)$$

From $\Delta 2$

$$\sin \theta = \frac{F_2}{80}$$

$$\Rightarrow \boxed{F_2 = 80 \sin \theta} \quad (3)$$

$$\cos \theta = \frac{R_2}{80}$$

$$\therefore \boxed{R_2 = 80 \cos \theta} \quad (4)$$

$$\cos \theta = \frac{F_1}{F}$$

$$\therefore \boxed{F_1 = F \cos \theta} \quad (2)$$

From $\Delta 2$

$$\sin \theta = \frac{F_2}{80}$$

$$\Rightarrow \boxed{F_2 = 80 \sin \theta} \quad (3)$$

$$\cos \theta = \frac{R_2}{80}$$

$$\therefore \boxed{R_2 = 80 \cos \theta} \quad (4)$$

$$\text{Since } F = \mu R.$$

$$\Rightarrow \sum F = \mu \cdot \sum R$$

$$\therefore F_1 - F_2 = \mu (R_1 + R_2)$$

$$\Rightarrow \begin{matrix} \downarrow & \downarrow \end{matrix} F \cos \theta - 80 \sin \theta = \mu \{ F \sin \theta + 80 \cos \theta \}$$

$$\therefore F \cos \theta - W \sin \theta = \mu F \sin \theta + \mu W \cos \theta$$

$$F \cos \theta - \mu F \sin \theta = \mu W \cos \theta + W \sin \theta$$

$$F \{ \cos \theta - \mu \sin \theta \} = W \{ \mu \cos \theta + \sin \theta \}$$

$$\therefore F = \frac{W \{ \mu \cos \theta + \sin \theta \}}{\{ \cos \theta - \mu \sin \theta \}}$$

$$\theta = 12^\circ$$
$$\mu = 0.4$$

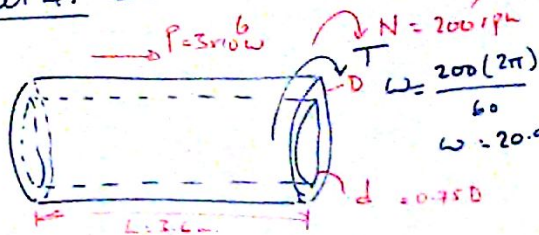
$$\sin 12^\circ = 0.21$$
$$\cos 12^\circ = 0.98$$

$$\therefore F = \frac{80[(0.4)(0.98) + (0.21)]}{[(0.98) - (0.4)(0.21)]}$$

$$\therefore \underline{\underline{F = 53.75 \text{ N.}}} = \text{min force required}$$

to start mass moving
up-slope.

Sheet 4. Q6.



$$\tau_{max} = 55 \times 10^6 \text{ N/m}^2$$

$$\omega = 20.94 \text{ rad/s} \quad G = 80 \times 10^9 \text{ N/m}^2$$

$$d = 0.75D$$

a) Find D.

b) Find θ over $L = 3.6 \text{ m}$.

$$\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{r}$$

$$J = 21.36 \times 10^{-3} \pi D^4$$

$$u.c.c : \frac{T}{J} = \frac{\tau}{r} \quad r = \frac{D}{2}$$

$$J = \frac{\pi d^4}{32} = \frac{\pi D^4}{32} - \frac{\pi d^4}{32}$$

$$= \frac{\pi}{32} (D^4 - d^4) \quad \text{But } d = 0.75D$$

$$= \frac{\pi}{32} (D^4 - (0.75D)^4)$$

$$J = \frac{\pi D^4}{32} (1 - 0.75^4)$$

$$J = \frac{\pi D^4}{32} (0.4836)$$

$$J = 21.36 \times 10^{-3} \pi D^4$$

$$\therefore \frac{T}{(21.36 \times 10^{-3} \pi D^4)} = \frac{\tau}{(\frac{D}{2})} = \frac{2\tau}{D}$$

$$\frac{D}{(21.36 \times 10^{-3} \pi D^4)} = \frac{2\tau}{T}$$

$$\pi D (21.36 \times 10^{-3}) = \frac{T}{2\tau}$$

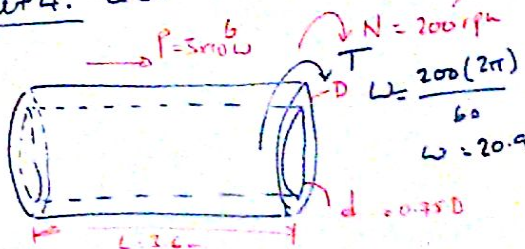
$$D^3 = \frac{T}{2\tau \cdot \pi (21.36 \times 10^{-3})}$$

$$P = T \cdot \omega$$

$$\rightarrow T = \frac{P}{\omega} = \frac{(3 \times 10^4)}{(20.94)}$$

$$\therefore T = 143.27 \times 10^3 \text{ N.m}$$

Sheet 4. Qb.



$\tau = 55 \times 10^6 \text{ N/m}^2$
 $T = 2000 \text{ Nm}$
 $\omega = 20.94 \text{ rad/s}$
 $G = 80 \times 10^9 \text{ N/m}^2$

- a) Find θ
 b) Find θ over $L = 3.6 \text{ m}$

$\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{r}$
 $J = 21.36 \times 10^{-3} \pi D^4$

$\therefore \frac{T}{J} = \frac{\tau}{r}$
 $r = \frac{D}{2}$

$J = \frac{\pi d^4}{32} = \frac{\pi D^4}{32} - \frac{\pi d^4}{32}$
 $= \frac{\pi}{32} (D^4 - d^4)$

$\frac{D^4}{D^3} = D^4 \cdot D^{-3} = D^{4-3} = D^1$

$\therefore \frac{T}{(21.36 \times 10^{-3} \pi D^4)} = \frac{\tau}{(\frac{D}{2})} = \frac{2\tau}{D}$

$J = \frac{\pi D^4}{32} (1 - 0.75^4)$

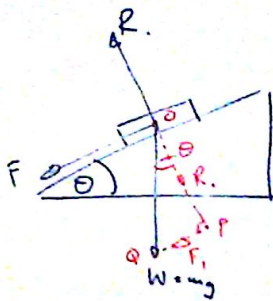
$P = T \cdot \omega$
 $\Rightarrow T = \frac{P}{\omega} = \frac{(3 \times 10^6)}{(20.94)}$

$\frac{D}{(21.36 \times 10^{-3} \pi D^4)} = \frac{2\tau}{T}$
 $\pi D (21.36 \times 10^{-3}) = \frac{T}{2\tau}$
 $D^3 = \frac{T}{2\tau \cdot \pi (21.36 \times 10^{-3})}$

$\frac{D}{D^4} = D^{-3} = \frac{1}{D^3}$

$J = \frac{\pi D^4}{32} (0.6836)$
 $J = 21.36 \times 10^{-3} \pi D^4$

$\therefore T = 143.27 \times 10^3 \text{ N.m}$



Q: What does $\mu = \tan \theta$ mean?

Answer

$$\sin \theta = \frac{F_1}{W}$$

$$\cos \theta = \frac{R_1}{W}$$

$$\frac{\sin \theta}{\cos \theta} = \tan \theta = \frac{\left[\frac{F_1}{W} \right]}{\left[\frac{R_1}{W} \right]} = \frac{F_1}{R_1} \cdot \frac{W}{W}$$

$$\therefore \tan \theta = \frac{F_1}{R_1} = \frac{F}{R} \quad \text{But } F = \mu R$$

$$\therefore \boxed{\tan \theta = \mu}$$

$$\therefore \frac{F}{R} = \mu$$

